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ANSI X3.254-199x

Fibre Channel – Mapping to HIPPI-FP

(FC-FP)

working draft proposed
American National Standard
for Information Systems

June 29, 1994

Secretariat:

Computer and Business Equipment Manufacturers Association

ABSTRACT: This standard defines the frame format and protocol definitions required to transfer information for upper-layer protocols that use the High-Performance Parallel Interface – Framing Protocol (HIPPI-FP) when using a lower-layer serial link interface operating according to the Fibre Channel – Physical and Signaling Interface (FC-PH) and Fibre Channel – Enhanced Physical (FC-EP) requirements.

NOTE:

This is a draft proposed American National Standard of Accredited Standards Committee X3. As such this is not a completed standard. The X3T9 Technical Committee may modify this document as a result of comments received during public review and its approval as a standard.

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American National Standard
for Information Systems –

Fibre Channel –
Mapping to HIPPI-FP (FC-FP)

Secretariat

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American National Standards Institute, Inc

Abstract

The described Specification defines the frame format and protocol definitions required to transfer information for upper-layer protocols that use the High-Performance Parallel Interface – Framing Protocol (HIPPI-FP) when using a lower-layer serial link interface operating according to the Fibre Channel – Physical and Signaling Interface (FC-PH) and Fibre Channel – Enhanced Physical (FC-EP) requirements.

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Contents

Foreword (This foreword is not part of American National Standard X3.254-199x.)

This standard defines the frame format and protocol definitions required to transfer information for upper-layer protocols that use the High-Performance Parallel Interface – Framing Protocol (HIPPI-FP) when using a lower-layer serial link interface operating according to the Fibre Channel – Physical and Signaling Interface (FC-PH) and Fibre Channel – Enhanced Physical (FC-EP) requirements.

This standard was developed by Task Group X3T9.3 of Accredited Standards Committee X3 during 1992. The standards approval process started in 1993.

This document includes an annex, which is informative and is not considered part of the standard.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the X3 Secretariat, Computer and Business Equipment Manufacturers Association, 1250 Eye Street, NW, Suite 200, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, the X3 Committee had the following members:

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Introduction

This Fibre Channel – Mapping to HIPPI-FP (FC-FP) standard defines the frame format and protocol definitions required to transfer information for upper-layer protocols that use the High-Performance Parallel Interface – Framing Protocol (HIPPI-FP) when using a lower-layer serial link interface operating according to the Fibre Channel – Physical and Signaling Interface (FC-PH) and Fibre Channel – Enhanced Physical (FC-EP) requirements. For example, the HIPPI upper-layer protocols would use FC-FP when the underlying physical layer is Fibre Channel, and would use HIPPI-FP when the underlying physical layer is HIPPI.

Figure 0.1 shows the relationship of this American National Standard (in the solid rectangle) with the other entities shown. In this document the term Fibre Channel refers to the FC-PH and FC-EP entities only. In relation to the Fibre Channel structures defined in FC-PH, this document, FC-FP, represents an FC-4.

Characteristics of FC-FP include:

– Encapsulation of HIPPI-FP packets, including the HIPPI-FP header, in Fibre Channel Information Units and Exchanges;

– Separation of the HIPPI-FP D1_Data_Set and D2_Data_Set.

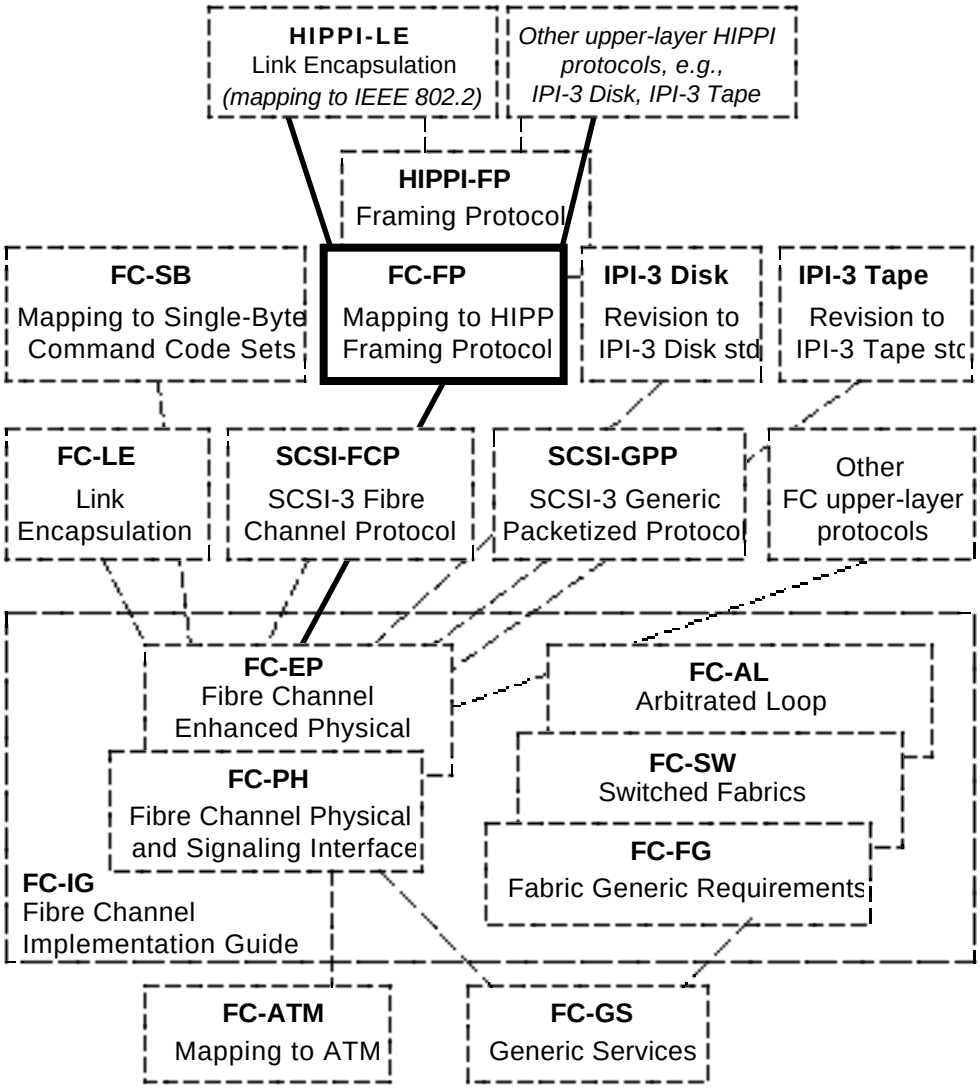

Figure 0.1 – Protocol hierarchy

American National Standard
for Information Systems –

Fibre Channel –
Mapping to HIPPI-FP (FC-FP)

1 Scope

This American National Standard provides a mapping for upper-layer protocols that use the High-Performance Parallel Interface – Framing Protocol (HIPPI-FP), to use the Fibre Channel – Physical and Signaling Interface (FC-PH) as the lower-layer transfer mechanism.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

ANSI X3.210-1992, *High-performance parallel interface, – framing protocol (HIPPI-FP).*

ANSI X3.230-199x, *Fibre Channel – Physical and Signaling Interface (FC-PH).*

3 Definitions and conventions

3.1 Definitions

For the purposes of this document, the following definitions apply.

3.1.1 connection control information (CCI): A parameter that identifies the destination of the IU.

3.1.2 Fibre Channel: The collective set of functions, operations, parameters, etc., defined in ANSI X3.230, Fibre Channel – Physical and Signaling Interface (FC-PH), and Fibre Channel – Enhanced Physical (FC-EP).

NOTE – The standards developers intend to place enhancements to ANSI X3.230, FC-PH, in the FC-EP document(s). While not mandatory for implementation of FC-FP, to insure maximum interoperability implementors are strongly advised to review the FC-EP document(s) for additional features.

3.1.3 information unit (IU): The constructs which define the payloads carried over Fibre Channel. The IUs define not only the data which is transparent to Fibre Channel, but also the use of some Fibre Channel control information and constructs.

3.1.4 upper-layer protocol (ULP): A protocol immediately above the FC-FP.

3.2 Editorial conventions

In this document, a number of conditions, mechanisms, parameters, or similar terms are printed with the first letter of each word in uppercase and the rest lowercase (e.g., Exchange, Class). Any lowercase uses of these words have the normal technical English meaning.

4 Information transmission

4.1 Source ULP and FC-FP

As defined in ANSI X3.210, a ULP user passes the following information to HIPPI-FP to request a data transfer. The same information shall be used by FC-FP. If a difference arises between the HIPPI-FP parameters referenced in this document and those specified in ANSI X3.210, then ANSI X3.210 (HIPPI-FP) takes precedence.

– CCI – Connection control information (destination for the information)

– ULP-id – Identifies the Destination ULP

– D1_Size – The length, in bytes, of the D1_Data_Set. The maximum size is 1016 bytes.

– D1_Data_Set – The information to be marked as control information and delivered ahead of the D2_Data_Set.

– D2_Size – The length, in bytes, of the D2_Data_Set. The maximum size is 4,294,967,294 bytes ($2^{32} – 2$). The HIPPI-FP capability of transferring an indeterminate amount of data by setting D2_Size to hexadecimal FFFFFFFF is supported by FC-FP. (See 4.2.1.6.)

– D2_Data_Set – The information to be marked as user data and delivered after the D1_Data_Set.

– Keep_Connection – Says that another ULP data set with the same routing information is coming, and the physical connection should be maintained if possible.

– Start_D2_on_Burst_Boundary – Controls whether the D2_Data_Set starts on a burst boundary or not.

Using these parameters, a HIPPI-FP packet header, as specified in ANSI X3.210, shall be constructed. The HIPPI-FP packet format is shown in figure 1 for reference. The D1_Area_Size shall be equal to the D1_Size (rounded up to an integral multiple of eight bytes). The HIPPI-FP packet, including the Header_Area, D1_Area, and D2_Area, shall then be passed to the Fibre Channel as one, or two, IU(s) for transmission. (See 4.2.1.2.)

NOTE – HIPPI-FP may only use a short burst, i.e., ≤ 1024 or 2048 bytes, for either the first or last burst of a packet. FC-FP does not have an equivalent restriction, and may use frame sizes to match the actual sizes of the data sets.

4.2 Source FC-FP and Fibre Channel

The relationship between the HIPPI-FP parameters and Fibre Channel entities is as follows:

– The CCI shall be used to derive the D_ID

– The HIPPI-FP packet, consisting of the Header_Area, D1_Area, and D2_Area, shall be sent as one or two Information Units (IUs).

– The Header_Area and D1_Area, as shown in figure 1, shall be sent as Information_Set_1 (I_S_1) with Information Category = Unsolicited Control. The maximum size is 1024 bytes.

– The D2_Area, as shown in figure 1, shall be sent as Information_Set_2 (I_S_2) with Information Category = Unsolicited Data.

– If Keep_Connection = 1, then the Fibre Channel should maintain a Class 1 connection when Class 1 is used. If Keep_Connection = 0, then a Class 1 connection may be released.

NOTE – The HIPPI Keep_Connection function is strictly advisory, it is not a mandate.

The source FC-FP shall notify the source ULP about the transmission status. The ULP will not issue another transfer request until this status is received. Status possibilities are:

– Accept – The FC-FP has accepted the packet (IU) for transmission. Note that this indication may be issued before all of the IU is transmitted.

– Reject – The FC-FP cannot deliver the packet (IU) because of a detected error.

– Timeout – The FC-FP could not deliver the packet (IU) within some timeout period. The suggested default value of this timeout is 10 seconds.

4.2.1 Mandatory Fibre Channel functions

4.2.1.1 Exchange

A Fibre Channel Exchange is equivalent to a HIPPI connection. Class 1 and 2 Exchanges are unidirectional for data transfers, with the reverse direction available for Abort operations.

4.2.1.2 Information unit (IU)

The IUs used to transfer HIPPI-FP packet information are shown in table 1. Mandatory IUs H2 and H3 package a HIPPI-FP packet in two separate IUs within the same Exchange. A HIPPI-FP packet with no D2_Area shall be transferred with an H2 IU.

Optional IU H1 packages a complete HIPPI-FP packet into one IU. H1 can only be used if the N_Ports support multiple Information Categories per Sequence.

4.2.1.3 Type code

The Type code shall equal HIPPI-FP.

4.2.1.4 Class of service

Class 1 or Class 2 may be used with FC-FP. Class 3 shall not be used.

4.2.1.5 Exchange Reassembly

More than one Fibre Channel N_Port may be used for higher data rates, i.e., Exchange_Reassembly may be used. The FC-FP shall specify to Fibre Channel if more than one N_Port may be used to transmit the IU(s).

4.2.1.6 Relative Offset

Relative Offset may be used in an implementation-dependent manner to collect or distribute data in the destination storage (reassembly) area. When transferring an indeterminate size D2_Data_Set, whose size may exceed 2^{32} – 2 bytes, then the Relative Offset shall be set to hexadecimal FFFFFFFF. (See 18.11 in ANSI X3.230.)

NOTE – The term "Relative Offset" relates to a Fibre Channel parameter. The terms "Offset" and "D2_Offset" relate to HIPPI-FP parameters.

4.2.2 Optional headers

4.2.2.1 Expiration/Security Header

The use of this header is both implementation and system dependent, and is beyond the scope of this document. (See ANSI X3.230 for usage of this header.)

4.2.2.2 Network Header

The use of this header is both implementation and system dependent, and is beyond the scope of this document. (See ANSI X3.230 for usage of this header.)

4.2.2.3 Association Header

The use of this header is both implementation and system dependent, and is beyond the scope of this document. (See ANSI X3.230 for usage of this header.)

4.2.2.4 Device Header

FC-FP does not use the Device Header.

4.3 Destination Fibre Channel and FC-FP

IUs are delivered to the Destination FC-FP in the same order as sent by the Source FC-FP.

The destination N_Port may pass the I_S_1 payload (Information Category = Unsolicited Control) to the destination FC-FP as soon as the I_S_1 has been received. Note that the I_S_2 portion may still be in transit from the source.

Any information received with Information Category other than Unsolicited Control or Unsolicited Data, shall be discarded by the destination FC-FP.

The destination FC-FP shall deliver the D1_Data_Set portion of the I_S_1 payload to the ULP identified by the ULP-id. The FC-FP shall also deliver the CCI, D2_Size, Offset, D1_Area_Size, and status. The HIPPI-FP header received in the I_S_1 payload contains the values of some of these parameters. (See figure 1.)

The destination N_Port may deliver the I_S_2 payload to the destination FC-FP as it is received. The destination N_Port shall notify the destination N_Port at the end of the IU.

The destination FC-FP may deliver the D2_Data_Set portion of the I_S_2 payload to the ULP identified by the ULP-id as it is received. The HIPPI-FP Offset bytes may be removed as the D2_Data_Set is placed in memory. The destination FC-FP shall pass the CCI, D2_Size, Offset, and status to the destination ULP when all of the IU has been received and delivered.

4.4 Fibre Channel interface failure

FC-FP shall be informed of the state of an N_Port. Specifically, FC-FP shall be informed whether communication is possible, i.e., the link is working and login to the Fabric (if present) and to the remote N_Port is complete. FC-FP shall make such information available to upper layer protocols as appropriate.

Table 1 – HIPPI-FP Information Units

IU Name	Category	Content	Category	Content	FML	Sequence Initiative	Mandatory / Optional
H1	Unsolicited Control	I_S_1 (HIPPI-FP Header and D1_Area)	Unsolicited Data	I_S_2 (HIPPI-FP D2_Area)	First, or Middle, or Last	Held	Optional
H2	Unsolicited Control	I_S_1 (HIPPI-FP Header and D1_Area)	———	———	First, or Middle, or Last	Held	Mandatory
H3	Unsolicited Data	I_S_2 (HIPPI-FP D2_Area)	———	———	Middle or Last	Held	Mandatory

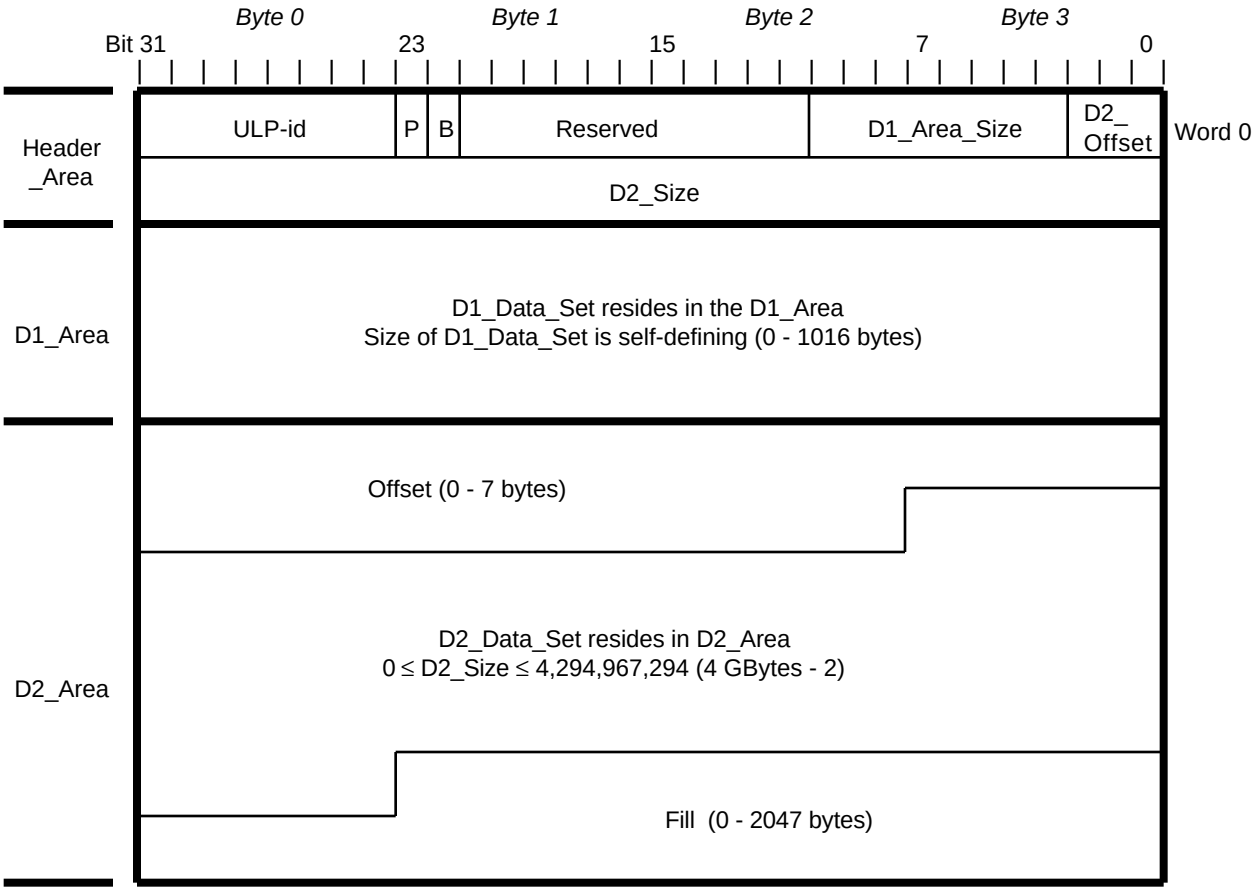

Figure 1 – HIPPI-FP packet format

Annex A
(informative)

Relationship to FC-PH service interface

A.1 General

Annex S of ANSI X3.230 is a service interface describing the interactions between FC-PH and upper-layer protocols such as FC-FP. For reference, figure A.1 shows the transfer service primitives described in ANSI X3.230. Their relationship to functions and parameters in this document are detailed below.

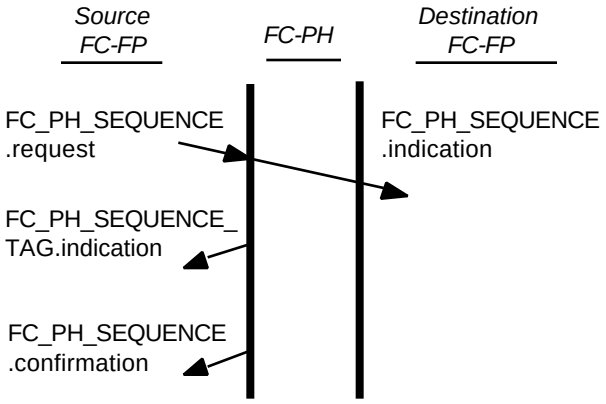

Figure A.1 – FC-PH service primitives

A.2 FC_PH_SEQUENCE.request

This primitive is issued by the Source FC-FP to transfer one or more Data Blocks within a single IU from the FC-FP entity to a single peer Destination FC-FP entity. FC-FP does not support multiple peer FC-FPs with group destination addresses.

FC_PH_SEQUENCE.request
(
Type,
Exchange_Tag,
Sequence_Tag,
Allowed_Class,
Routing_Bits,
D_ID,
S_ID,
First_Sequence,
Last_Sequence,
Chained_Sequence,
Sequence_Initiative,
Continue_Sequence_Condition,
Exchange_Error_Policy,
Relative_Offset_Present,
Exchange_Reassembly,
Data_Field_Control,
Expiration_Security_Header,
Network_Header,
Association_Header,
Device_Header,
Information_Category(1),
Block_Offset(1),
Data_Block(1),
Information_Category(2),
Block_Offset(2),
Data_Block(2)
)

Type = HIPPI-FP (See 4.2.1.3.)

Exchange_Tag is used by the Source FC-FP if multiple FC-PHs are being used simultaneously to transfer data at a faster rate than available with a single FC-PH, i.e., striping with Exchange Reassembly. Otherwise, the Source FC-PH assigns the Exchange_Tag at the beginning of an Exchange. FC-FP uses the same Exchange_Tag when sending additional IUs in the same Exchange.

Sequence_Tag is not used by FC-FP, the Source FC-PH assigns the Sequence_Tag.

Allowed_Class = Class 1, Class 2, or both. (See 4.2.1.4.)

Routing_Bits = binary 0000

D_ID is the Destination Address, and is derived from the CCI. (See 4.2.)

S_ID is the Source Address, and is not supplied by the FC-FP, it is assigned by the FC-PH N_Port.

First_Sequence is set by the Source FC-FP for the first Sequence of an Exchange. Since an Exchange is equivalent to a HIPPI connection, the first Sequence is the first IU sent in a connection.

Last_Sequence is set by the Source FC-FP on the last Sequence of an Exchange. Since an Exchange is equivalent to a HIPPI connection, the last Sequence is the last IU sent during a connection.

Chained_Sequence is not used by FC-FP.

Sequence_Initiative is always held by the Source FC-FP, and never transferred to the Destination FC-FP.

Continue_Sequence_Condition is used to perform the HIPPI Keep_Connection function. (See 4.1 and 4.2.)

Exchange_Error_Policy used by FC-FP is Abort, Discard multiple Sequences.

Exchange_Reassembly may be used to stripe multiple FC-PH N_Ports for the transmission of IUs at higher data rates than possible with a single N_Port. (See 4.2.1.5.)

Data_Field_Control is used to signify which, if any, optional headers are included by the Source FC-FP. (See 4.2.2.)

Expiration_Security_Header may be included by the Source FC-FP. (See 4.2.2.1.)

Network_Header may be included by the Source FC-FP. (See 4.2.2.2.)

Association_Header is not used by FC-FP. (See 4.2.2.3.)

Device_Header is not used by FC-FP. (See 4.2.2.4.)

Each set of Information_Category, Block_Offset, and Data_Block specifies one Data Block for transmission and is referenced as a subrequest. A Data Block is a unit of data with a single Information_Category and a single associated offset.

Information_Category for each IU is specified in 4.2 and table 1.

Block_Offset may be used by FC-FP for each IU transferred.

Data_Block is the information transferred, and is specified in 4.2 and table 1 for each IU.

There are two sets of Data_Block, Block_Offset, and Information_Category when transferring an H1 IU as shown in table 1. There will be a single set of Data_Block, Block_Offset, and Information_Category when transferring an H2 or H3 IU as shown in table 1.

A.3 FC_PH_SEQUENCE_TAG.indication

This primitive is issued by the Source FC-PH in response to the FC_PH_SEQUENCE.request primitive issued by the Source FC-FP entity.

FC_PH_SEQUENCE_TAG.indication
(
Type,
Exchange_Tag,
Sequence_Tag
)

Type = HIPPI-FP (See 4.2.1.3.)

Exchange_Tag is the local identifier of the Exchange, either the one supplied by FC-FP, or the one assigned by FC-PH.

Sequence_Tag is the local identifier of the Sequence, as assigned by FC-PH, used to transmit the IU.

A.4 FC_PH_SEQUENCE.indication

This primitive is issued by the Destination FC-PH to deliver a received IU to the Destination FC-FP.

FC_PH_SEQUENCE.indication
(
Type,
Exchange_Tag,
Class,
Routing_Bits,
D_ID,
S_ID,
First_Sequence,
Last_Sequence,
Chained_Sequence,
Sequence_Initiative,
Continue_Sequence_Condition,
Exchange_Error_Policy,
Relative_Offset_Present,
Exchange_Reassembly,
Data_Field_Control,
Expiration_Security_Header,
Network_Header,
Association_Header,
Device_Header,
Information_Category(1),
Block_Offset(1),
Data_Block(1),
Information_Category(2),
Block_Offset(2),
Data_Block(2),
Sequence_Valid
)

Type = HIPPI-FP (See 4.2.1.3.)

Exchange_Tag is assigned by the Destination FC-PH and passed to the Destination FC-FP.

Class is the class used for this IU. (See 4.2.1.4.)

Routing_Bits = binary 0000, as set by the Source FC-FP.

D_ID is the Destination Address used to deliver this IU.

S_ID is the Source Address that originated this IU transfer.

First_Sequence means that this is the first IU of this Exchange.

Last_Sequence means that this is the last IU for this Exchange.

Chained_Sequence is not used by FC-FP.

Sequence_Initiative is always held by the FC-FP Source, and never transferred to the FC-FP Destination. Transfer of Sequence_Initiative to the Destination should be treated as an error.

Continue_Sequence_Condition is used to perform the HIPPI Keep_Connection function. (See 4.1 and 4.2.)

Exchange_Error_Policy should be Abort, Discard multiple Sequences, as set by the Source FC-FP. Any other Exchange_Error_Policy should be treated as an error.

Exchange_Reassembly indicates that multiple FC-PH N_Ports were used to transmit the IU. (See 4.2.1.5.)

Data_Field_Control is used to signify which, if any, optional headers were included by the Source FC-FP. (See 4.2.2.)

Expiration_Security_Header may be present. (See 4.2.2.1.)

Network_Header may be present. (See 4.2.2.2.)

Association_Header may be present. (See 4.2.2.3.)

Device_Header is not used by FC-FP. (See 4.2.2.4.)

Each set of Information_Category, Block_Offset, and Data_Block specifies one Data Block received. A Data Block is a unit of data with a single Information_Category and a single associated offset.

Information_Category for each IU is specified in 4.2 and table 1. Information_Category values other than specified in 4.2 should be treated as errors.

Block_Offset may be used by FC-FP for each IU transferred.

Data_Block is the information transferred, and is specified in 4.2 and table 1 for each IU.

There are two sets of Data_Block, Block_Offset, and Information_Category when receiving an H1 IU as shown in table 1. There will be a single set of Data_Block, Block_Offset, and Information_Category when receiving an H2 or H3 IU as shown in table 1.

Sequence_Valid will be set for Sequences with all frames received and valid.

A.5 FC_PH_SEQUENCE.confirmation

This primitive is issued by the Source FC-PH to indicate to the Source FC-FP the success or failure of the FC_PH_SEQUENCE.request transfer request.

FC_PH_SEQUENCE.confirmation
(
Type,
Exchange_Tag,
Sequence_Tag,
Transmission_Status,
Reject_Reason
)

Type = HIPPI-FP (See 4.2.1.3.)

Exchange_Tag is the same as that supplied by the Source FC-PH in the FC_PH_SEQUENCE_TAG.indication primitive. (See A.3.)

Sequence_Tag is the same as that supplied by the Source FC-PH in the FC_PH_SEQUENCE_TAG.indication primitive. (See A.3.)

Transmission_Status indicates status as one of the following:
– Successful – IU successfully delivered to Destination FC-FP
– Unsuccessful – IU was not delivered successfully due to abort or frame transfer error.
– Stopped_by_Recipient – Destination stopped IU as indicated in ACK
– Rejected_Request – The IU was not sent by the Source FC-PH due to the specified Reject_Reason.
– Rejected_by_Fabric – Reject frame received from Fabric
– Rejected_by_N_Port – Reject frame received from Destination N_Port

Reject_Reason (See Annex S of ANSI X3.230.)